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Energy Reliability in Industry

IETC June 20, 2017

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Service Offerings

Energy Optimization Services:

- Energy Efficiency Assessments
- Energy Management Program Development
- Energy Maintenance Best Practices
- Electricity Best Rates Analysis
- Electricity Invoice Auditing
- Utility Strategy Development
- Utility Supply Configuration Optimization

Energy Reliability Services:

- Identify solutions to unscheduled utility outages
- Electricity Supply & Distribution Reliability
- Evaluation of interdependency of all utility systems to avoid the “weak links”

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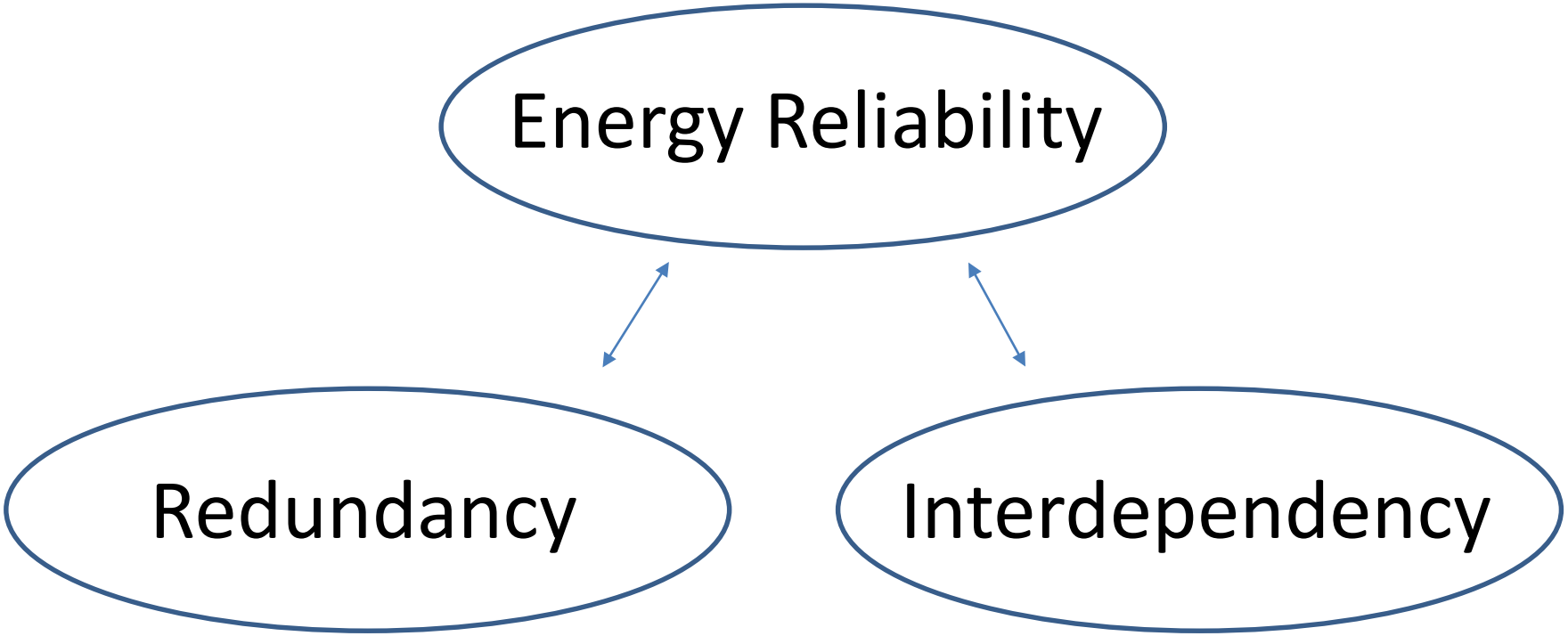
AGENDA

1) Value of an ERA
2) The ERA process
3) N-1 Definition
4) Benefits of an ERA
5) Examples from previous ERAs
6) Summary


Energy Reliability
Redundancy
Interdependency


400 MW power outage
due to operational failure
in 220 kV switchgear
Lost Revenue
= € 30 Mio

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Power cuts blow for Dow Chemical factories

CHEMICALS

By Hal Weitzman in Chicago

Dow Chemical, one of the US's biggest chemicals makers, reported second-quarter earnings below Wall Street's expectations as power cuts affected production facilities in the US and Latin America.

The group was one of the few big US companies to disappoint in an earnings season that has been marked by better-than-expected profits and a string of improved outlooks for the rest of the year.

The earnings come a week after DuPont, another big US chemicals manufacturer, reported profits well ahead of analysts' expectations and raised its full-year outlook, saying sales were growing across the board and in all regions.

Dow earned net profit of $651m, or 50 cents per share, compared with a loss of $344m, or 47 cents per share, in the same period a year ago. However, that was still below analysts' consensus forecasts of about 54 cents per share.

Revenues also disappointed: Dow took in $13.6bn in the quarter, 20 per cent ahead of last year but short of expectations for $13.7bn.

The company's shares were trading 9.3 per cent lower at $25.70 by midday in New York, helping to drag down the broader stock market.

$300m

Loss of revenue at plants in Texas and Argentina

Dow was affected by power cuts at two of its facilities in Texas during the quarter, while a similar problem at a plant in Argentina shut down production for one month, costing the company $300m in revenue, or 7 cents per share in income.

The company also suffered in the quarter from wet weather in the US and unseasonably cold conditions in Europe that affected pesticide applications. Dow added that millions of acres of Canadian farmland went unplanted because of floods.

Nevertheless, the chemicals maker saw a 7 per cent increase in volume and a 19 per cent increase in price in the quarter. Sales increased strongly in all regions, ranging from 14 per cent in Latin America to 31 per cent in North America.

"Our US macroeconomic view remains guardedly optimistic," said Andrew Liveris, chief executive.

"We continue to have confidence that momentum is gradually building, and we have not changed our view of a sustained global recovery led by Asia, slowly helped by the US recovery, but with Europe lagging."

Mr Liveris tried to delay, but was ultimately forced to go ahead last year, with a deal to buy Rohm & Haas, the speciality chemicals group, for $15.3bn, a price widely seen as overvalued, even after Dow's Kuwaiti partners pulled out, depriving the US company of $9.5bn it had planned to put towards the acquisition.

Dow cut its dividend and took a $9.2bn short-term loan to complete the Rohm & Haas deal. The company said yesterday it had saved $325m in the quarter by cutting structural costs from the takeover.

Why reliability studies?

Lost Revenue = $ 300 Mio

or 7 cents per share in income.

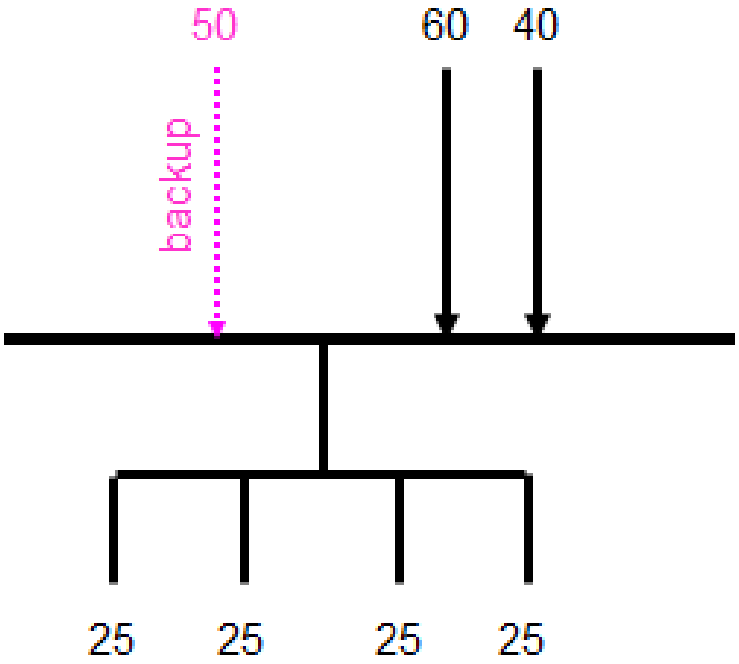
Outage Scenario (utility interdependency)

Site XYZ experiences a power outage to one of its many electrical feeders. This feeder happens to be the sole supply to all of the air compressors. The pneumatics are subsequently lost to all valves so the boilers trip and the production process shuts down!

Definition of N-1

N-1 is an installation practice that allows adequate supply to consumers in the event of the failure of the single largest generator.

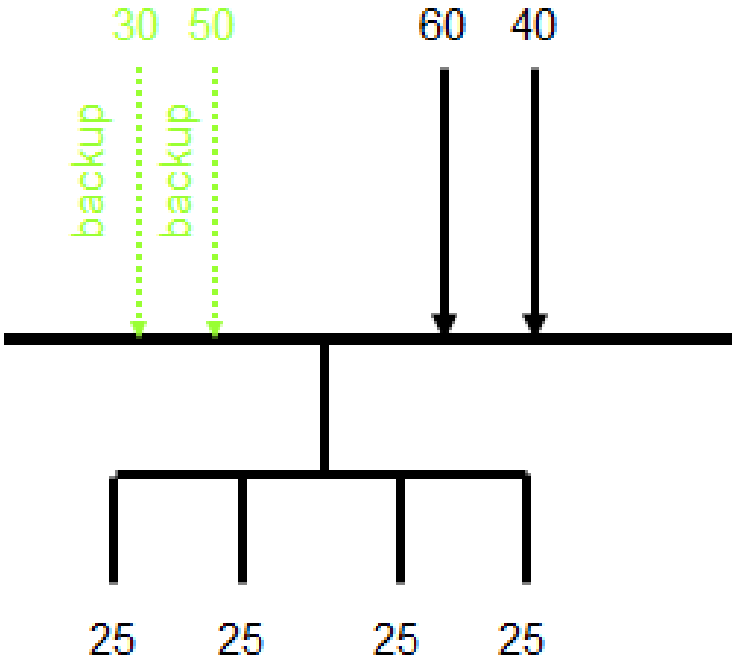
Case 1



Demand =100; if the element with the capacity of 60 fails, the demand can not be longer satisfied.

☐ **n-1 not fulfilled**

Case 2



Demand =100; if the element with the capacity of 60 fails, the demand can still be satisfied.

☑ **n-1 fulfilled**

Load Duration Curve

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Pre-study	1	2	3	Post-study
Preparation of the study	**Site Briefing**	**Work in 2nd Phase**	**Final Meeting**	**Creation of the report**
Questionnaire	**Half day**	**Ca. 1 day/util.**	**half day/util.**	**Ca.two weeks**
■ Basic data ■ Feedstocks ■ Generation ■ Distribution etc.	■ Process ■ Scope ■ Check of Basic data	■ Expert Team ■ Site Team ■ URC – Utility Reliability Check	■ Analyze inspection for all remaining positions	■ Documentation of the findings
Picture of: ■ Current situation ■ capacities ■ structures ■ customers	Agreement: ■ Utilities ■ People involved ■ Documents ■ Classification	Deployment: ■ What if scenarios ■ Plant structure ■ Functional structure	Adjustment: ■ Discussion of Findings ■ Assessment of risk ■ Recommendat.	Summary: ■ Positive aspects ■ Weak points ■ Recommendat.

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	Mon., Aug 25th	Tue., Aug 26th	Wed., Aug 27th	Thu., Aug 28th	Fri., Aug 29th
8:00 am		Kick-off	Compressed Air	Wrap-up, or spillover as needed	
		Utilities Site tour	Clarified, Demineralized, & Waste Water		
		General Reliability Concept			
12:00 am					
1:00 pm		Electricity supply and distribution	Fuel/Natural Gas		
		Steam & Condensate	Nitrogen		
5:00 pm					

utility	used on site	supply	to be studied
Electrical Power			
Process Water			
Service Water			
Fire Water			
Cooling Water			
Demineralized Water			
Potable Water			
Steam			
Condensate			
Compressed Air			
Instrument Air			
Breathing Air			
Utility Air			
Chilled Water			
Thermal Fluid			
Nitrogen			
Fuel / Natural Gas			
Waste Water			

utility	used on site	supply	to be studied
Electrical Power	+	buy	+
Process Water	+	make	+
Service Water	-	-	-
Fire Water	+	make	-
Cooling Water	+	make	+
Demineralized Water	+	make	+
Potable Water	+	make	-
Steam	+	make/buy	+
Condensate	+	make/buy	+
Compressed Air	+	make	+
Instrument Air	+	make	-
Breathing Air	-	-	-
Utility Air	-	-	-
Chilled Water	-	-	-
Thermal Fluid	-	-	-
Nitrogen	+	buy	+
Fuel / Natural Gas	+	buy	+
Waste Water	+	buy	+

Energy Reliability Assessments, North America

Utility Studied	Site A	Site B	Site C	Site D	Site E	Site F	Site G	Site H	Site I
Natural Gas/Fuels	X	X	X	X	X	X	X	X	X
Nitrogen	X	X	X	X	X	X	X	X	X
Waste Water	X	X	X	X	X	X	X	X	X
Compressed Air	X	X	X	X	*	X	X	X	X
Steam/Condensate	X	**	X	X	X	X	X	X	X
Demineralized Water	X	X	X	X		X			X
Clarified Water		X	X	X	X				X
Soft Water					X		X		
Process Water						X		X	
Cooling Tower Water	X	X							
Chilled Water	X								
River Water								X	
Filtered Water								X	
Fire Water								X	
Year Completed	2008	2009	2010	2012	2013	2013	2013	2014	2014
Electricity (separate from URC)	2007	2007	2007	2007	2013	2013	2012	2014	2014

* = Completed outside of URC

** = Considered Process not Utility

1) A transparent view of the utility reliability situation
2) Document the as-is status
3) Strengths and opportunities are identified
4) Organizational items are covered
5) Energy efficiency opportunities are often discovered
6) Provides a review of existing concepts
7) The process provides a second independent opinion

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Electrical Power Supply

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Strengths:

- Dual 69kV supplies on separate poles
- Looped structure allowing dual feed to process loads
- **Having the third 20 MVA transformer on site (for manual switching availability)**
- The site maintains a “close” and cooperative relationship with NEP which results in increased response time to incidents

Opportunities:

- **Redundant transformers do not exist in most 480V installations**
- **Redundant transformers do not exist at any 4160V installations**
- A majority of the on-site equipment has reached or is close to the end of its useful life
- A wooden pole inspection system does not exist

Immediate measures:

- **Establish a wooden pole inspection program**
- Complete detailed electrical system study and determine implementation steps
- Replace oil switches with newer technology units

Middle and long term measures:

- **Build redundancy into 4160V and 480V transformer installations**
- **Replace 2B and 2B1 substations (refer to numerous historical events)**

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Steam System

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Strengths:

- Boilers B6 and B7 are newly installed with the latest control technology
- Steam is generated at 600 psig and the loads require 250 psig offering a “buffer” for pressure control
- Boilers B6 and B7 have are centrally located within the site vs, the prior configuration of having the supply significantly removed from the load.
- Multiple let down stations provides flexibility
- Large quantity of BFW storage capacity
- **N-1 exists**
- The steam production from SAR can off-set the Prowl steam load

Opportunities:

- **Boilers B6 and B7 are supplied electricity from the same loop**
- High age of some boilers (#1,#2 age>40 years)
- The steam output from SAR should not be relied upon as a continuous source
- HBT consumption practice is cyclic, swinging 25,000 lbs per hour, contributing to peak demand. This could be a weakness in the event of curtailment along with coincidental peaking.

Immediate measures:

- Commission B6 and B7

Middle and long term measures:

- **Reconfigure boiler electrical supply to be fed from separate loops.**
- Finalize plans for the retirement of B1 and B2
- **Establish a written steam curtailment plan**

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Clarified Water

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Strengths:

- Newly installed Calri-cone and sand filter systems.
- Mississippi River water supply permit and intake structure are in place. BASF is currently pursuing purchase of this permit/equipment.
- Excess clarifier capacity allows for maintenance.
- Big Blue storage capacity.
- Proximity to Mississippi River for future sourcing.

Opportunities:

- **N-1 capacity is not fulfilled for well water supply for peak demands.**
- **Supply header bottle neck.**
- **The underground supply header has reached the end of useful life.**
- **Branch piping is transite (asbestos containing) leading to complications in repair.**
- Potential vulnerability during Big Blue TAR.
- Contractual limitations on well 13.
- The clarified water storage tank is under sized.

Immediate measures:

- Continue to pursue improvements (distribution header and surge).
- Commission Clari-cone.
- Continue use of temporary surge (frac tanks).

Middle and long term measures:

- •Continue to pursue supply option from Mississippi River.
- Continue to pursue Capital Plan improvements.

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Instrument Air

Strengths:

- **Connections for a rental dryer are in place.**
- **Connections for a rental compressor (diesel) are in place.**
- When HBT is in operation their air compressor can supplement the BASF instrument air header.
- All process areas have installed air receiver tanks.

Opportunities:

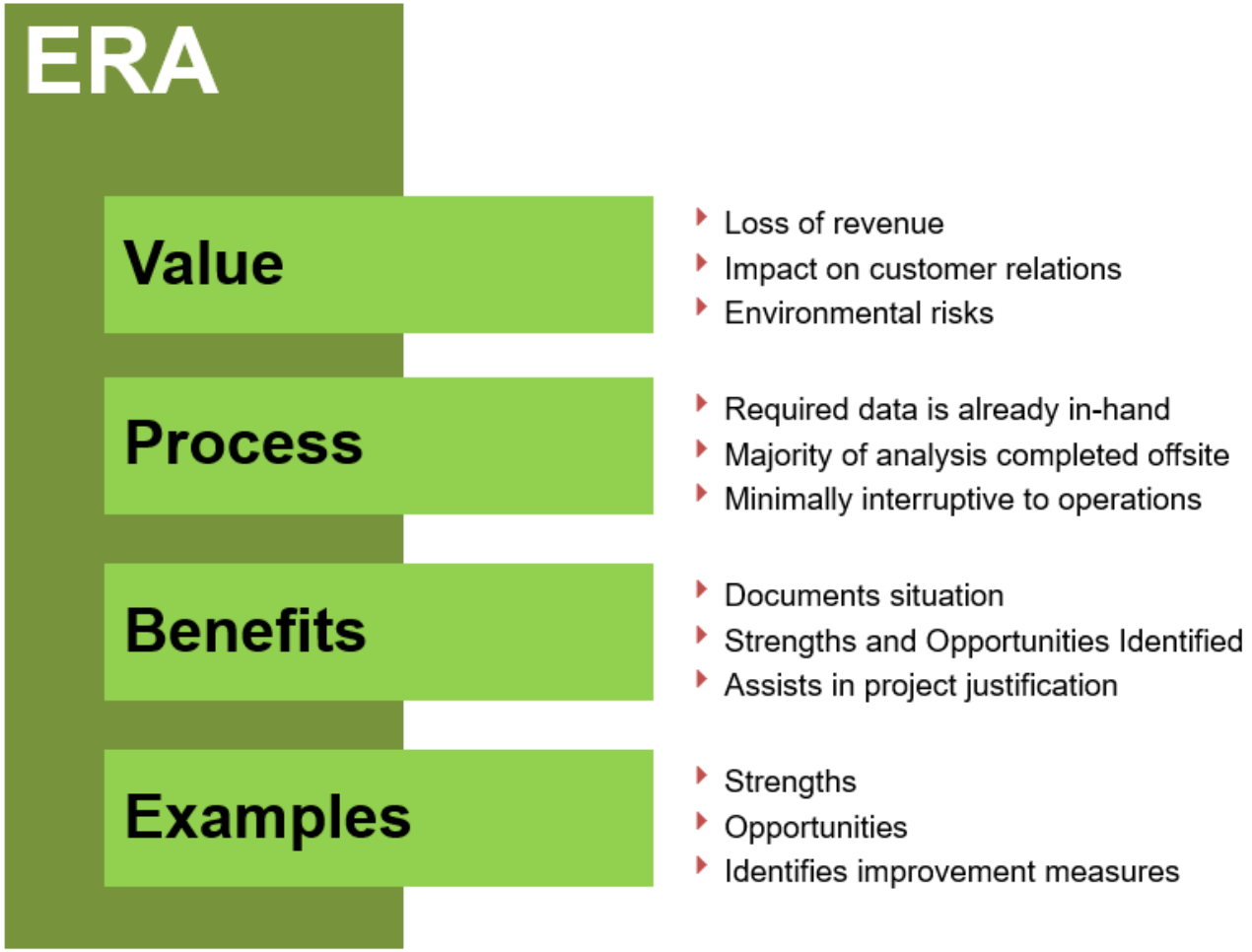
- A back-up air dryer is not permanently installed.
- A standard minimal pressure set point does not exist within process areas. A site wide standard should be developed.
- The compressors are approaching end of useful life.
- **N-1 installed capacity does not exist.**
- The air dryer capacity limits max flow to 2,500 cfm (peak demand is currently 2,400 cfm).
- An external water spray is installed to cool the oil coolers (oil coolers under sized).

Immediate measures:

- None

Middle and long term measures:

- Review the previous Ingersoll Rand air system study with BASF Energy Management and IR (Al Giffen) upon planning if additional capacity.
- **Identify AOD installations and demand to determine opportunities for load reduction.**
- Proceed with instrument air compressor replacement plans (see Capital Plan 2016).
- Include instrument air dryer replacement plans and/or duplication of units into the Capital Plan.
- Address oil cooler limitations.


ERA
Value
Loss of revenue
Impact on customer relations
Environmental risks
Process
Required data is already in-hand
Majority of analysis completed offsite
Minimally interruptive to operations
Benefits
Documents situation
Strengths and Opportunities Identified
Assists in project justification
Examples
Strengths
Opportunities
Identifies improvement measures

Any Questions?

Thank you for you attention!

For more information please contact:
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